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(54) **Combined microwave and forced convection oven.**

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Description

This invention relates to a microwave and forced convection or steam oven with gas or electric heating of the food disposed in the cooking chamber of the oven.

Forced convection ovens with gas or electric heating of the food, particularly utilized in the community kitchens (schools, hospitals, mess halls, and so on), are well-known, these types of ovens consisting essentially of an exterior metal casing enclosing a cooking chamber through which a motor-driven fan creates a flow of hot air which, in the case of a gas oven, is mixed with the combustion gas produced by a burner located in a corresponding combustion chamber communicating with both said cooking chamber and the exterior of the oven and, in the case of an electric oven, is heated by corresponding electric heating elements located inside the cooking chamber itself.

These gas or electric ovens, due to the direct heating of the food, allow a shorter cooking time as well as a higher thermal efficiency.

In addition, in the case of a gas oven, the circulation of the combustion gas through the food assures that meat, fish and the like can be grilled in a more satisfactory manner.

Forced convection ovens with gas or electric indirect heating of the food are also well-known, these ovens consisting essentially of at least one heat exchanger housed, together with a fan for the hot air flow, in a further oven chamber, separate from the cooking chamber, but in communication with it, said heat exchanger being composed - in the case of a gas oven - of a group of tubular conduits conveying the combustion gas and connected with both the combustion chamber and an exhaust outlet and - in the case of an electric oven - of a plurality of electric heating elements. These ovens, due to their well-known characteristic of temperature uniformity within the cooking chamber, are particularly suited for cooking food contained in pans, chiefly metal pans, arranged one atop the other on different levels throughout the height of the cooking chamber.

Therefore, with this type of ovens it is possible to contemporaneously cook the food contained in a plurality of pans, each one of them taking up the entire inner area of the cooking chamber.

Combined microwave and thermal ovens which achieve the simultaneous cooking according to the foregoing description are well-known as it is also well-known the excellent fast cooking performance attainable with such a type of ovens. However, due to the opacity of the metal to the microwave radiation, generally it is possible to treat with microwave radiation only the food contained in that pan which is directly exposed to the microwave source since the other pans, being "obscured" by the first pan, will not be exposed to the radiation source. Further, even if the pan is not made of metal, but of another material transparent to the microwaves, as for instance certain types of ceramic, the food contained in that pan which is directly exposed to the radiation will actually absorb most of the irradiated energy with the consequence that the food contained in the other pans would not be cooked properly.

Therefore, with this type of ovens it is possible to heat with both the thermal and microwave modes only one pan at a time.

Combined microwave and thermal ovens which cook the food contained in a plurality of pans arranged one atop the other inside the cooking chamber of the oven are also well-known (e.g. as claimed in the European patent No. 0068161, priority 20-6-1981).

However, in these ovens the magnetrons are mounted above the cooking chamber and the microwaves are directed toward the latter by one or more waveguides vertically disposed on the cooking chamber side walls thus catercorner irradiating the pans through a plurality of spaced microwave slots.

This type of ovens present however the following disadvantages:

- The vertical waveguides take up a considerable serviceable space inside the cooking chamber.
- The established levels at which the various microwave slots are placed are greatly restricting the freedom with which the pans can be placed vertically throughout the height of the cooking chamber.

A remarkable unevenness is created in the propagation of the waves owing to both an asymmetry of the waveguides with respect to the pans and the fact that the intensity of the radiation field has a decreasing pattern starting from the highest slot toward the bottom ones.

Finally, microwave ovens are known to employ pairs of magnetrons which are arranged symmetrically outside the side walls of the cooking chamber and propagate microwaves through waveguides that flow into said cooking chamber only with an aperture whose cross-section area is limited by their own size (such as for instance in US patent specification no. 4,835,351 priority Oct. 10, 1985).

Only a food container at a time can however be loaded in the cooking chamber of microwave ovens of this type, since, due to the limited cross-sectional area of the microwave source, possible food containers that are arranged away from the radiation plane, as defined by the two apertures from which microwaves are propagating, and in particular near the ceiling or the bottom of the cooking

chamber, would be flushed only unevenly by the microwaves due to the other containers arranged therebetween progressively masking away from the microwaves the containers placed farther away.

The Patent US 4,140,888 discloses a magnetron only that supplies microwave energy to the chamber from both side walls through a waveguide that is separated in two branches which are reaching the two side walls of the cooking chamber from the top.

That brings to an asymmetrical energy propagation into the two chamber portions, the higher and the lower ones, that are separated by the intermediate horizontal rack.

Such an asymmetrical propagation is caused by two reasons:

1) The amount of the electromagnetic field intensity, and therefore of the energy supplied from a plurality of emitting apertures from the same waveguide, is the higher the closer said emitting apertures are placed from the energy emitting source;

The higher and the lower portions are irradiated sequencially from the same waveguide (ref. is made to fig. 1).

Therefore this geometrical configuration causes a remarkable unbalance in the energy sharing between the two chamber portions laid one upon the other.

Such an inconvenience could theoretically be overcame in said Patent configuration if the height of the two vertical panels 32, made of microwave not absorbent material, would be properly differentiated, so that the two different chamber portions are supplied with the same energy amount.

However that requires notably different heights in the two chamber portions, what is fully unacceptable in a volume oven for catering use, to which this oven is dedicated and that requires a plurality of strctly identical chamber portions in a rack configuration, evenly supplied with microwave energy.

2) The second reason why, to us, this configuration would not be a relevant priority derives from the fact that the left wall is supplied from the magnetron that is positioned on the right side. The obvious consequence of this configuration is that the energy entering the left side is lower that the energy entering the right side, due to the energy attenuation in the horizontal path of the transmitting waveguide 25.

To sum up, the US 4,140,888 proposed configuration creates a double unbalance in the energy sharing in the cooking portions, because the energy entering the top chamber portion is higher that the energy entering the bottom portion, and because the energy distribution in each side portion is uneven and is a function of the distance from the left or from the right side walls, what is specially unacceptable in a volume microwave oven for catering use.

The US Patent n. 2,593,067 discloses a M.W. oven comprising two symmetrical magnetrons for the heating of food contained in the container 2. However the configuration proposed is only aimed to increase the M.W. power in the cooking cavity without incurring in the unfavorable conditions when one of the magnetrons tends to absorb the radio-frequency power of the other one, acting as an additional load across said other, instead of supplying radio-frequency power to the common load in the oven as desired.

No hypotesis is discussed in the case that more containers are placed one above the other into the cooking cavity, and therefore no proposal is given in order to supply evenly the M.W. energy to said plurality of food containers.

Therefore, it is desirable and it is an object of this invention to provide an oven capable of contemporaneously carrying out cooking programmes both in the thermal and microwave modes, utilizing a plurality of pans, also metal pans, set one atop the other throughout a significant height of the cooking chamber thus taking up the entire volume of said cooking chamber, and capable of ensuring a remarkable radiation uniformity on different planes as well as on different zones of the same plane so as to attain all of the aforesaid advantages that this type of cooking implies.

This cooking oven is achieved with the constructive features substantially described herein and with particular reference to those set forth in the appended claims.

This invention will be best understood from the following description given by way of non-limiting example when read in connection with the accompanying drawings, in which:

- Fig. 1 is a schematic front view of a cooking oven according to a first embodiment of this invention;
- Fig. 2 is a top view of the oven shown in Fig. 1;
- Fig. 2a is a front view of a variation of the waveguide system from the magnetrons to the cooking chamber;
- Fig. 2b is a top view of the same variation;
- Fig. 3 is an elevation external plan view of a construction detail of the oven shown in Fig. 1;
- Fig. 4 is a horizontal sectional view of the construction detail shown in Fig. 1;
- Fig. 5 is an elevation side projection of the construction detail shown in Fig. 3;

- Fig. 6 is a perspective view of a side wall of the cooking chamber;
- Fig. 7 is a horizontal view of the motor-fan coupling according to a further improvement of this invention;
- Fig. 8 shows the detail of Fig. 7 after the fan has been removed.

With reference to Fig. 1 and 2 showing a forced convection and microwave cooking oven utilized for community kitchens, it can be seen that it substantially consists of a metal casing 6 enclosing a cooking chamber 7 in which are housed some special shelves or pans 8 set one atop the other, on which the food to be cooked is placed, said shelves being inserted and removed in an advantageous way with respect to the side guides 9 of the cooking chamber 7, previous opening of the oven front door 10.

Said cooking chamber 7 is subdivided into a further inner chamber 11 by a partition wall 12 extending along the entire height and part of the width of the cooking chamber, the latter being in communication with said inner chamber 11 by means of some side openings 14 and a central opening 15a provided on the partition wall 12 for the hot air circulation, the inner chamber 11 being provided with a centrally disposed fan 15 driven by a coaxial electric motor 16 mounted externally against the rear wall 17 of the oven. The fan 15 is laterally delimited by a group of tubular conduits 18 arranged close to its circumferencial edge, said tubular conduits 18 being properly bent so as to encircle said fan 15 and being connected with their upper and lower ends respectively with one or more discharging chimneys located on the upper part of the oven and with a not indicated combustion chamber placed in the lower part of the oven and housing at least a conventional gas burner.

An electric heating as an alternative to the gas heating can be achieved by arranging suitable resistors, preferably circular resistors, around the periphery of the fan 15.

The microwave heating is obtained by disposing externally and symmetrically to the cooking chamber 7 two magnetrons 22 and 23, said magnetrons being connected to said cooking chamber by two corresponding lateral and symmetric trumpets 24 and 25 which cover the respective magnetrons and have the triple aim of avoiding the escape of radiations to the exterior, of guiding the radiations toward the cooking chamber and of containing a special propagation mixing device 26, 27 well-known from the state of the art as a "stirrer".

It is well-known that the stirrers, during the magnetron operation, are kept continuously in a rotational condition by appropriate motors 29a and 29b. It has been experimentally proved that with a proper combination of the shape, size and position of the trumpets and of the shape, size and position of the stirrers it is possible to deflect the radiations emitted by the two magnetrons along a radiation field which propagates in a substantially plane and uniform manner from the full height of the two side walls toward the interior of the cooking chamber.

The position of the trumpets is illustrated in Fig. 1 and 2.

The position of the stirrers inside the trumpets is shown in Fig. 2, 3, 4 and 5.

It has been found that if some pans (two of them at least) are introduced inside the cooking chamber so as to take up the entire available area and they are so disposed one atop the other so as to leave a clearance 28 between the bottom of the upper pan and the top of the lower pan equal to at least to a half-wave as indicated in Fig. 1, the propagation coming from the walls penetrates said clearance and hit uniformly the food contained in the lower pan.

As a result, said clearance practically becomes a new and smaller cooking chamber contained in the original cooking chamber, the former being delimited up and down respectively by the bottom of the upper pan and the bottom of the lower pan.

Therefore, if a plurality of pans are inserted at a proper height one from the other, smaller adjacent cooking chambers are created, all of them being hit by the microwave propagation.

In short, by inserting some pans horizontally and at a suitable height one from the other so as to take up all the available inner space, as many cooking chambers are created in which the cooking of the food contained in each pan can be effected contemporaneously both in the heating and microwave modes.

The shape, size and position of said trumpets 24 and 25, the shape, size and position of the corresponding stirrers and the orientation of the magnetrons are shown in Fig. 1, 2, 3, 4 and 5.

With reference to these figures, it can be seen that the two magnetrons 22 and 23 are placed over but however externally to the side walls and in a central position with respect to said cooking chamber. The radiations emitted by said magnetrons is guided by two downwardly oriented, symmetrical and vertically disposed waveguides 50 and 51, substantially extending down to the bottom 52 of the cooking chamber, the walls 53 and 54 being facing the inside of the cooking chamber constituting an integral part of the respective walls 55 and 56 of said cooking chamber, so that the walls 53 and 54 are part both of the walls of the respective waveguides and of the corresponding cooking chamber walls.

The just described oven is fit to attain the wanted result of performing a microwave cooking programme in a cooking chamber housing a plural-

ity of pans set one atop the other. Nevertheless, it still remains the problem consisting in the fact that it is not possible to superpose the pans without carrying out some other modifications. In fact, as a rule, the pans are introduced into the cooking chamber 7 by fitting their borders onto horizontal metallic guides parallelly disposed at different heights on both side walls of said cooking chamber.

It is apparent that if the cooking chamber is designed according to this invention, the radiations which propagate from the trumpets 24 and 25, will directly hit said guides and, being by them obstructed at once, they will also create the conditions for a serious congruity impairment between the cooking chamber and the two trumpets.

Moreover, in the larger ovens, especially in those utilized for community kitchens, the forced convection takes place by drawing the air from a central opening provided on the rear wall of the cooking chamber and by blowing this air, after it has been heated, into said cooking chamber, through a plurality of slots 14 made on the side walls of said chamber, preferably on the entire height of said walls, said slots being obtained in the free space between the pan supporting guides 9 as shown in Fig. 6.

It is apparent that this type of structure is inconsistent with the direct utilization of this invention since the guides 9 and the air ducts present on the side walls would originate a very serious obstacle to the normal microwave propagation.

To avoid this hindrance, it has been found that a heat resisting and microwave-transparent material as for instance ceramic, polytetrafluoroethylene, polyether-etherketone, polysulfone or other material with similar characteristics can advantageously be used for producing said guides.

A further improvement of this invention is the following: it is known that the microwave ovens must comply with the safety requirements set forth in the existing specifications and in particular to those specifications related to the emission of microwave radiations.

In a thermal and forced convection oven of the type hereinbefore described it can occur that the shaft 30 of the fan 15 placed behind the rear wall of the cooking chamber is protruding with its front end inside the inner chamber and therefore is acting, as a matter-of-fact, as an elementary receiving antenna.

If, as a rule, said shaft extends backward outside the rear wall of the oven, as it is shown in Fig. 2, said shaft becomes, as far as the propagation is concerned, a transmitting antenna which propagates outside the oven, the radiation that it picked up inside the inner chamber 7, thus affecting the safety requirements.

The known solutions to this problems are:

- Shaft partially or totally made of microwave-transparent material (for instance ceramic, which however implies a remarkable brittleness).
- Provide a chamber not concerned with the microwave radiation, where the shaft enters in the conventional way (e.g. by providing a convection cooking chamber back-cell in which the partition wall between the latter and the cooking chamber cannot be removed unless it is provided with a special choke, in which case it can be removed only by a technician).

However, these remedies present the inconvenience that they do not allow the access into said back-cell for performing the normal cleaning operations.

If it is wanted that said partition wall could be removed by the user, it would be then necessary to provide a safety circuit to preclude the oven operation when said partition wall is removed.

Furthermore, for performing a normal cleaning operation of the fan and of the cell in which it is housed, it is a common practice to withdraw said fan from the inside of the cooking chamber; in this case, if the fan is not remounted, the shaft of its related motor will protrude, as it normally occurs, inside said cell thus acting as a receiving antenna which picks up the radiations coming from the cooking chamber and retransmits them toward the motor and hence outside the oven.

As shown in Fig. 7, to avoid these further inconveniences, it has been found advantageous to have the metal motor shaft 30 crossing the wall of the cell in correspondence with a toroidal choke 31 consisting of a fixed cylindrical part 32 (welded to the cell itself) and a rotating part 33, the latter being integral with the rotating element, which can be made of metal.

The characteristic of said choke 31 is that its two component parts 32 and 33 resemble to two different sized small cups inversely inserted one into the other. The hollow space 31 forms a labyrinth for the microwave propagation and if the depth of said labyrinth exceeds a quarter of the wave length, then, as it is well-known, said labyrinth will act as an effective obstruction to the microwave propagation. moreover, to avoid that when the fan is removed, the shaft 30 could act as a receiving antenna, the diameter of the fixed cylindrical part 32 should be smaller or equal to a quarter of the wavelength and its depth longer than said limits, as indicated in Fig. 8.

It is understood that what has been described and illustrated herein by way of non-limiting example to be read in connection with the accompanying drawings may be subject to various modifica-

tions and structural changes without departing from the scope of this invention.

Claims

1. A combined microwave and heating oven, especially utilized for community kitchens, consisting of
   - a cooking chamber (7), on the side walls of which two or more guides (9) for supporting the food containing pans (8) are fixed;
   - a door (10) for opening and closing said cooking chamber (7);
   - two magnetrons (22, 23) for microwave generation, characterized by
   - each magnetron (22, 23) placed externally of the respective side wall of the cooking chamber (7) at the same height and symmetrically with respect to a vertical center plane of said cooking chamber (7);
   - two motor-driven stirrers (26, 27) for mixing said microwaves from the respective magnetrons (22, 23);
   - two trumpets (24, 25) conveying said microwaves from the respective magnetrons (22, 23) to the interior of the cooking chamber (7);
   - each trumpet (24, 25) attached to the respective side wall and each trumpet (24, 25) extending along the entire height of the side walls of said cooking chamber (7) so that the microwave radiation field horizontally propagates in a substantially plane and uniform manner from the entire height of the two side walls towards the interior of the cooking chamber (7).

2. An oven according to the preceding claim, wherein each one of said stirrers (26 and 27) consists of a ring shaped as an extended rhombus made of reflecting material and a brace connecting two opposite vertexes of said rhombus, said stirrers being connected in the central zone of said brace with the horizontal rotation shaft.

3. An oven according to the preceding claim, wherein the height (A) of said trumpets is about the double of their widths (L).

4. An oven according to claim 1 to 3, wherein the trumpets (24 and 25) have the shape of containers open towards the interior of the cooking chamber (7), the upper and lower corners of the trumpets being replaced by inclined walls (24a, 25a and 24b, 25b) respectively, symmetrically disposed with respect to a horizontal plane passing through the centre of said trumpets, said walls being inclined of about 45 degrees with respect to the upper wall (24c) and the external wall (25c) of said trumpets.

5. An oven according to any one of the preceding claims, wherein along the side walls of said cooking chamber a plurality of horizontal guides (9) are disposed, said guides being used as a support for corresponding food containings pans (8) and being made of microwave-transparent material.

6. an oven according to any one of the preceding claims, comprising also a vertical rear wall (12) which separates the cooking chamber (7) from a further cell (11), a fan (15) located inside said cell, utilized for the hot air and steam circulation between said cooking chamber and the heating means (18), a motor (16), connected through a transmission shaft (30) to said fan (15), wherein the mechanical coupling between said shaft (30) and the fan (15) is achieved by connecting said shaft (30) to a bushing (35) integral with the fan (15), the bushing being provided with a cylindrical profile (33), circumferential to said shaft and fitted on the fixed cylindrical profile (32) obtained by means of an appropriate profiling of the rear wall of the oven, said shaft (30) being positioned in such a way as to have its end (36) not protruding beyond the edge (37) of the cylindrical profile (32), said coaxial cylindrical profiles (32, 33) being dimensioned in such a way that the cylindrical hollow space between said profiles is shorter than the microwave quarter-wave.

7. An oven according to the preceding claim, wherein the fixed cylindrical profile (32) has a diameter not larger than the microwave quarter-wave and a depth not lower than said value.

Patentansprüche

1. Kombinierter Mikrowellen- und beheizter Back- und Bratofen, insbesondere vom in Großküchen zum Einsatz kommenden Typ, mit
   - einem Garraum (7), an dessen Seitenwänden zwei oder mehrere Führungsleisten (9) zum Tragen der Speisenbehälter (8) befestigt sind;
   - einer zum öffnen und Schließen des genannten Garraums (7) dienenden Tür (10);
   - zwei Magnetrons (22, 23) zur Mikrowellenerzeugung,

   dadurch gekennzeichnet, daß:

- jedes Magnetron (22, 23) außerhalb der jeweiligen Seitenwand des Garraums (7) auf der gleichen Höhe und symmetrisch mit Bezug auf die zentrale Lotebene des genannten Garraums (7) angeordnet ist;
- zwei motorangetriebene Rührvorrichtungen (26, 27) zur Mischung der von den jeweiligen Magnetrons (22, 23) erzeugten Mikrowellen vorgesehen sind;
- zwei trichterförmige Strahlungshörner (24, 25) vorgesehen sind, die die genannten Mikrowellen aus den jeweiligen Magnetrons (22, 23) in das Innere des Garraums (7) hineinleiten;
- jedes Strahlungshorn (24, 25) an der jeweiligen Seitenwand befestigt ist und jedes Strahlungshorn (24, 25) sich die ganze Höhe der Seitenwände des genannten Garraums (7) hindurch erstrecken, sodaß das Mikrowellenstrahlungsfeld sich horizontal auf einer im wesentlichen gleichmäßigen Ebene von der ganzen Höhe der beiden Seitenwände nach dem Innern des Garraums (7) ausbreiten kann.

2. Kombinierter Mikrowellen- und beheizter Back- und Bratofen nach dem Vorhergehenden Anspruch, **dadurch gekennzeichnet, daß** jede der genannten Rührvorrichtungen (26 und 27) aus einem Ring aus reflektierendem Material, der die Form eines verlängerten Rhombus hat, sowie aus einem Diagonalsteg besteht, der zwei entgegengesetzte Ecken des Rhombus miteinander verbindet, wobei die genannten Rührvorrichtungen im mittleren Bereich des genannten Steges mit der jeweiligen horizontalen Drehantriebswelle verbunden sind.

3. Kombinierter Mikrowellen- und beheizter Back- und Bratofen nach dem vorhergehenden Anspruch, **dadurch gekennzeichnet, daß** die Höhe (A) der genannten trichterförmigen Strahlungshörner annähernd das Zweifache ihres Breitenmaßes (L) ausmacht.

4. Kombinierter Mikrowellen- und beheizter Back- und Bratofen nach den Vorhergehenden Ansprüchen 1 bis 3, **dadurch gekennzeichnet, daß** die genannten Strahlungshörner (24 und 25) die Form von nach dem Innern des Garraums (7) hin offenen Gefäßen aufweisen, wobei die oberen und unteren Ecken der Strahlungshörner jeweils durch symmetrisch mit Bezug auf eine durch den Mittelpunkt der genannten Strahlungshörner verlaufende Horizontalebene angeordnete Schrägwände (24a, 25a und 24b, 25b) ersetzt sind, wobei solche Schrägwände eine Neigung von ca. 45 Grad mit Bezug auf die obere Wand (24c) und die äußere Wand (25c) der genannten Strahlungshörner aufweisen.

5. Kombinierter Mikrowellen- und beheizter Back- und Bratofen nach irgendeinem der Vorhergehenden Ansprüche, **dadurch gekennzeichnet, daß** eine Anzahl von horizontal verlaufenden Führungsleisten (9) enlang der Seitenwände des genannten Garraums (7) angeordnet sind, wobei solche Führungsleisten zum Tragen von entsprechenden Gargutbehälter (8) dienen und aus einem mikrowellendurchläßigen Material bestehen.

6. Kombinierter Mikrowellen- und beheizter Back- und Bratofen nach irgendeinem der vorhergehenden Ansprüche, mit zusätzlich einer Vertikalrückwand (12) , die den Garraum (7) von einer weiteren Kammer (11) trennt, einem Gebläse (15), das innerhalb der genannten Kammer angeordnet ist und zur Heißluft- und Dampfzirkulation zwischen dem genannten Garraum (7) und Heizmitteln (18), sowie einem mittels einer Antriebswelle (30) mit dem genannten Gebläse (15) verbundenen Motor (16), **dadurch gekennzeichnet, daß** die mechanische Kopplung zwischen der genannten Antriebswelle (30) und dem Gebläse (15) unter Verbindung der genannten Antriebswelle (30) mit einer mit dem Gebläse (15) fest verbundenen Büchse (35) erzielt wird, und daß die genannte Büchse mit einem die genannte Antriebswelle umkreisenden, dem durch spezielle Profilgebung der Ofenrückwand erzielten festen Zylinderprofil (32) angepaßten Zylinderprofil (33) versehen ist, und daß die genannte Antriebswelle (30) so angeordnet ist, daß ihr Endteil (36) nicht über den Rand (37) des Zylinderprofils (32) hinausragt, sowie daß solche koaxialangeordnete Zylinderprofile (32, 33) so bemessen sind, daß der sich zwischen solchen Profilen bildende Zylinderhohlraum kürzer als eine Mikrowellen-Viertelwelle ist.

7. Kombinierter Mikrowellen- und beheizter Back- und Bratofen nach dem vorhergehenden Anspruch, **dadurch gekennzeichnet, daß** das feste Zylinderprofil (32) einen Durchmesser, der nicht größer als ein Viertel der Mikrowellenlänge ist, sowie eine Tiefe aufweist, die nicht kleiner als der genannte Wert ist.

Revendications

1. Four de cuisson combiné a micro-ondes et chauffage, en particulier du type utilisé dans les cuisines professionelles, comprenant

- une enceinte de cuisson (7), sur les parois latérales de laquelle deux ou plusiers glissières (9) sont pourvues en tant que supports pour les récipients (8) contenant les aliments à cuire;
- une porte (10) apte à ouvrir et fermer ladite enceinte de cuisson (7);
- deux magnétrons (22, 23) en tant que générateurs de micro-ondes,

caractérisé en ce que

- chacun desdits magnétrons (22, 23) est situé à l'extérieur de la paroi latérale respective de l'enceinte de cuisson (7), à la même hauteur et symétriquement par rapport à un plan central vertical de ladite enceinte de cuisson (7);
- deux agitateurs (26, 27) commandés par moteur sont pourvus pour mélanger et distribuer les micro-ondes provenant des magnétrons respectifs (22, 23);
- deux trompes de rayonnement des micro-ondes (24, 25) sont pourvues pour diriger lesdites micro-ondes des magnétrons respectifs (22, 23) jusqu'à l'intérieur de l'enceinte de cuisson (7);
- chacune desdites trombes de rayonnement (24, 25) est fixée à sa respective paroi latérale, chaque trombe de rayonnement (24, 25) en question s'étendant tout au long de l'entière hauteur des parois latérales de ladite enceinte de cuisson (7), de façon telle que le champ de rayonnement des micro-ondes se propage horizontalement dans un plan essentiellement uniforme en se déplaçant de toute la hauteur des deux parois latérales vers l'intérieur de l'enceinte de cuisson (7).

2. Four de cuisson combiné à micro-ondes et chauffage selon la revendication précedente, **caractérisé en ce que** chacun desdits agitateurs (26 et 27) est formé par un anneau ayant la forme d'un rhombe allongé de matériau réfléchissant, ainsi que par un élément diagonal reliant entre eux deux sommets opposés dudite rhombe, lesdits agitateurs se rejoignant avec l'arbre de rotation horizontal en correspondance de la zone centrale dudit élément diagonal.

3. Four de cuisson combiné à micro-ondes et chauffage selon la revendication précedente, **caractérisé en ce que** la hauteur (A) desdites trombes de rayonnement est à peu près égale au double de leur largeur (L).

4. Four de cuisson combiné à micro-ondes et chauffage selon les revendications 1 à 3, **caractérisé en ce que** les trombes de rayonnement (24 et 25) ont la forme de récipients s'ouvrant vers l'intérieur de l'enceinte de cuisson (7), les coins supérieur et inférieur des trombes en question étant remplacés par des parois inclinées (24a, 25a et 24b, 25b) respectivement, qui sont disposées symétriquement par rapport à un plan horizontal passant à travers le centre desdites trombes de rayonnement. lesdites parois étant inclinées d'environ 45 degrés par rapport à la paroi supérieure (24c) et à la paroi extérieure (25c) desdites trombes de rayonnement.

5. Four de cuisson combiné à micro-ondes et chauffage selon l'une quelconque des revendications précedentes, **caractérisé en ce qu'**une pluralité de glissières horizontales (9) sont disposées tout au long des parois latérales de ladite enceinte de cuisson (7), lesdites gliessères étant utilisées en tant que supports pour des récipients correspondants (8) contenant les aliments à cuire et étant fait d'un matériau transparent aux micro-ondes.

6. Four de cuisson combiné à micro-ondes et chauffage selon l'une quelconque des revendications précedentes, comprenant aussi une paroi de fond verticale (12) séparant l'enceinte de cuisson (7) d'une autre enceinte (11) ultérieurement pourvue, un ventilateur (15) situé à l'intérieur de cette enceinte ultérieure et utilisé pour la circulation de l'air chaud et de la vapeur entre ladite enceinte de cuisson et des moyens de chauffe (18) y pourvus, ainsi qu'un moteur (16) relié par un arbre de transmission (30) audit ventilateur (15), **caractérisé en ce que** l'accouplement mécanique entre ledit arbre (30) et le ventilateur (15) est réalisé en joignant ledit arbre (30) à une douille (35) solidaire du ventilateur (15), ladite douille étant pourvue d'un profil cylindrique (33) circonférentiel audit arbre et adapté sur le profil cylindrique fixe (32) qui est obtenu en conférant un profil approprié à la paroi arrière du four, ledit arbre étant positionné d'une façon telle que son extrémité (36) ne saille pas de la couronne (37) du profil cylindrique (32), lesdits profils cylindriques coaxiaux (32, 33) étant dimensionnés de façon telle que l'interstice cylindrique se formant entre lesdits profils est plus court qu'un quart d'onde des micro-ondes.

7. Four de cuisson combiné à micro-ondes et chauffage selon la revendication précedente, **caractérisé en ce que** le profil cylindrique fixe (32) a un diamètre qui ne dépasse pas un quart de la longueur d'onde des micro-ondes,

ainsi qu'une profondité qui n'est pas inférieur à ladite valeur.

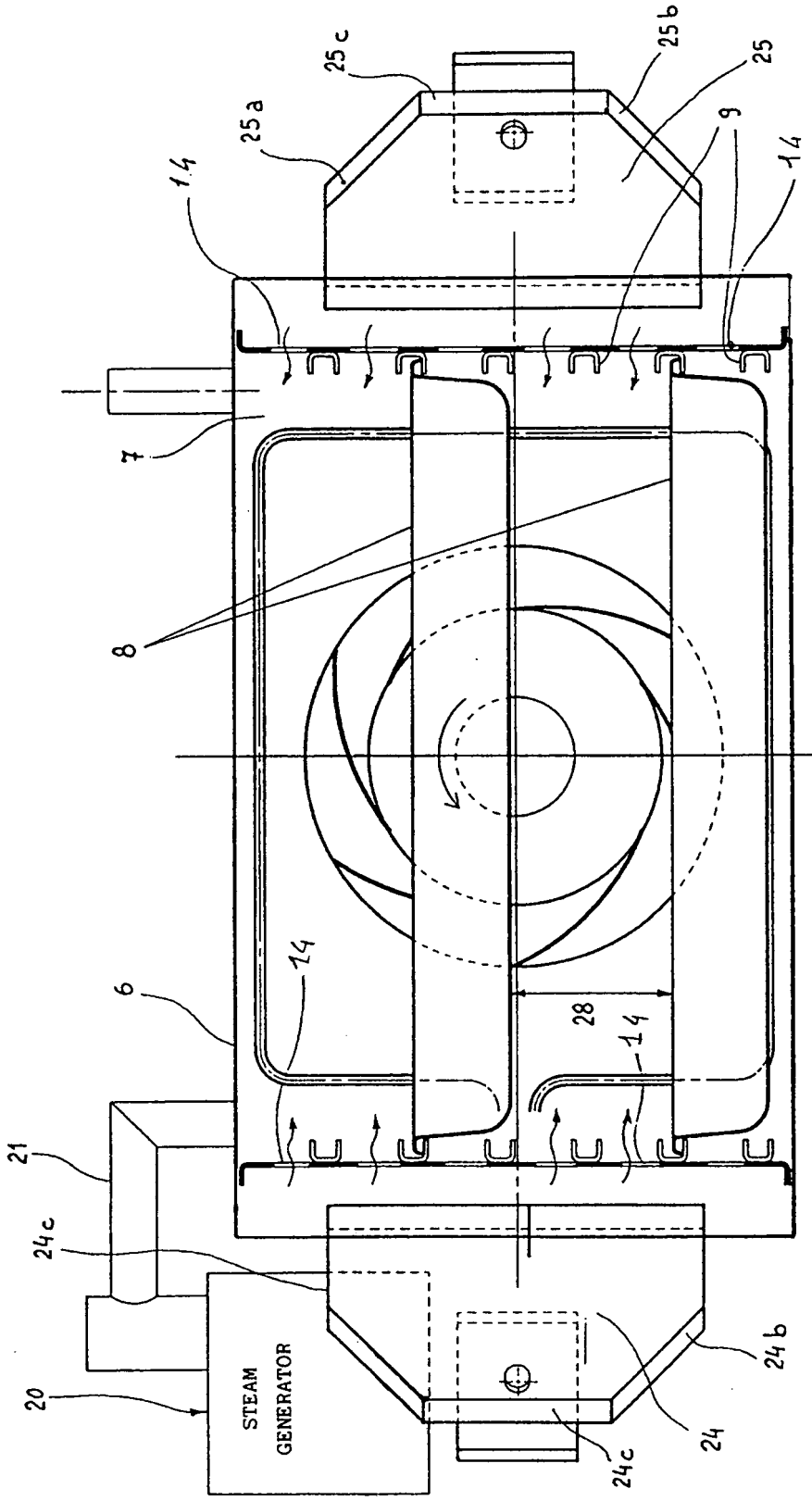
25c
25b
25
25a
9
14
14
7
8
6
14
28
14
21
24c
20
STEAM
GENERATOR
24b
24
24c

FIG. 1

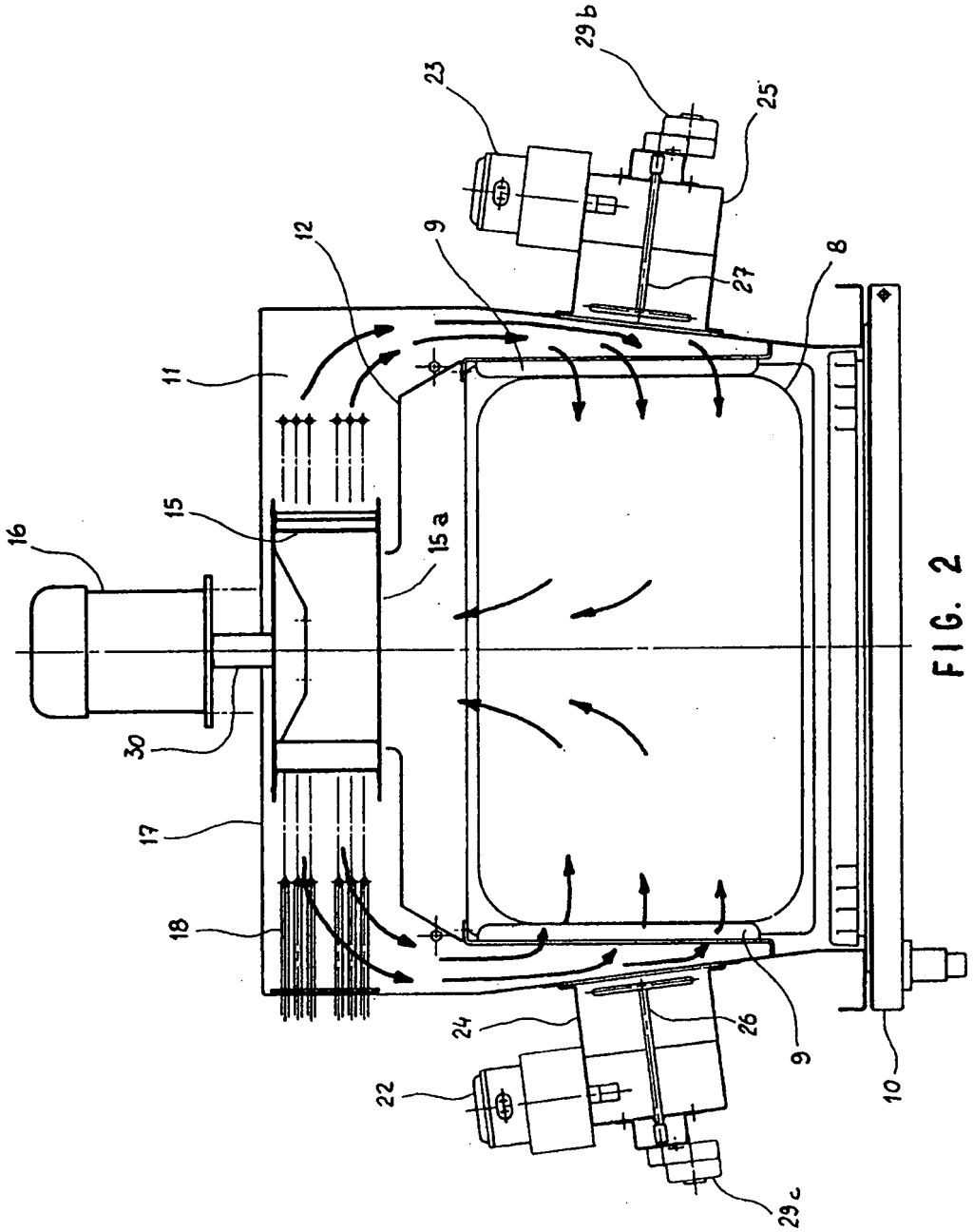

FIG. 2

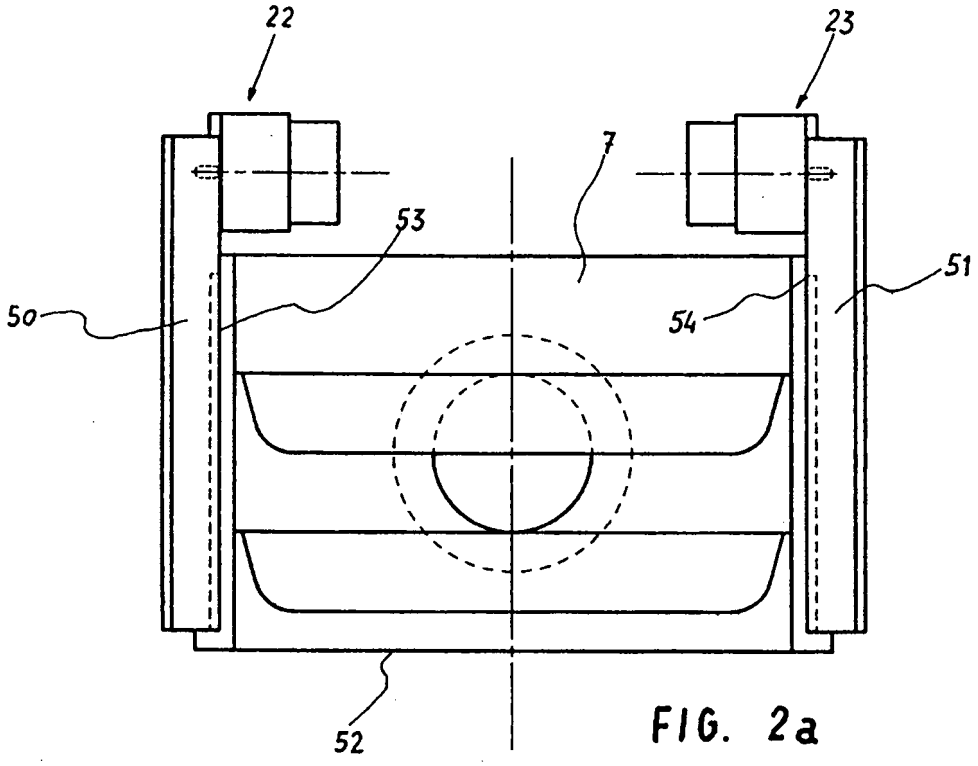

FIG. 2a

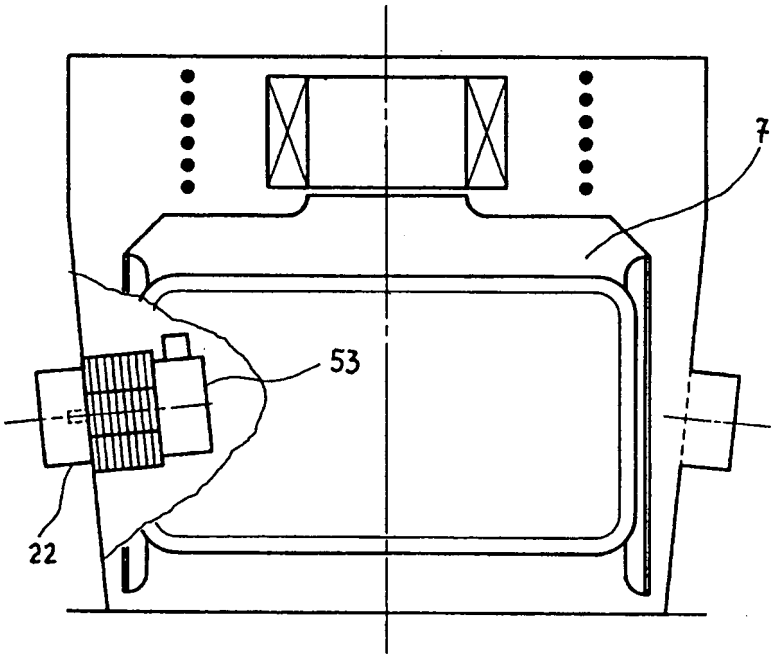

FIG. 2b

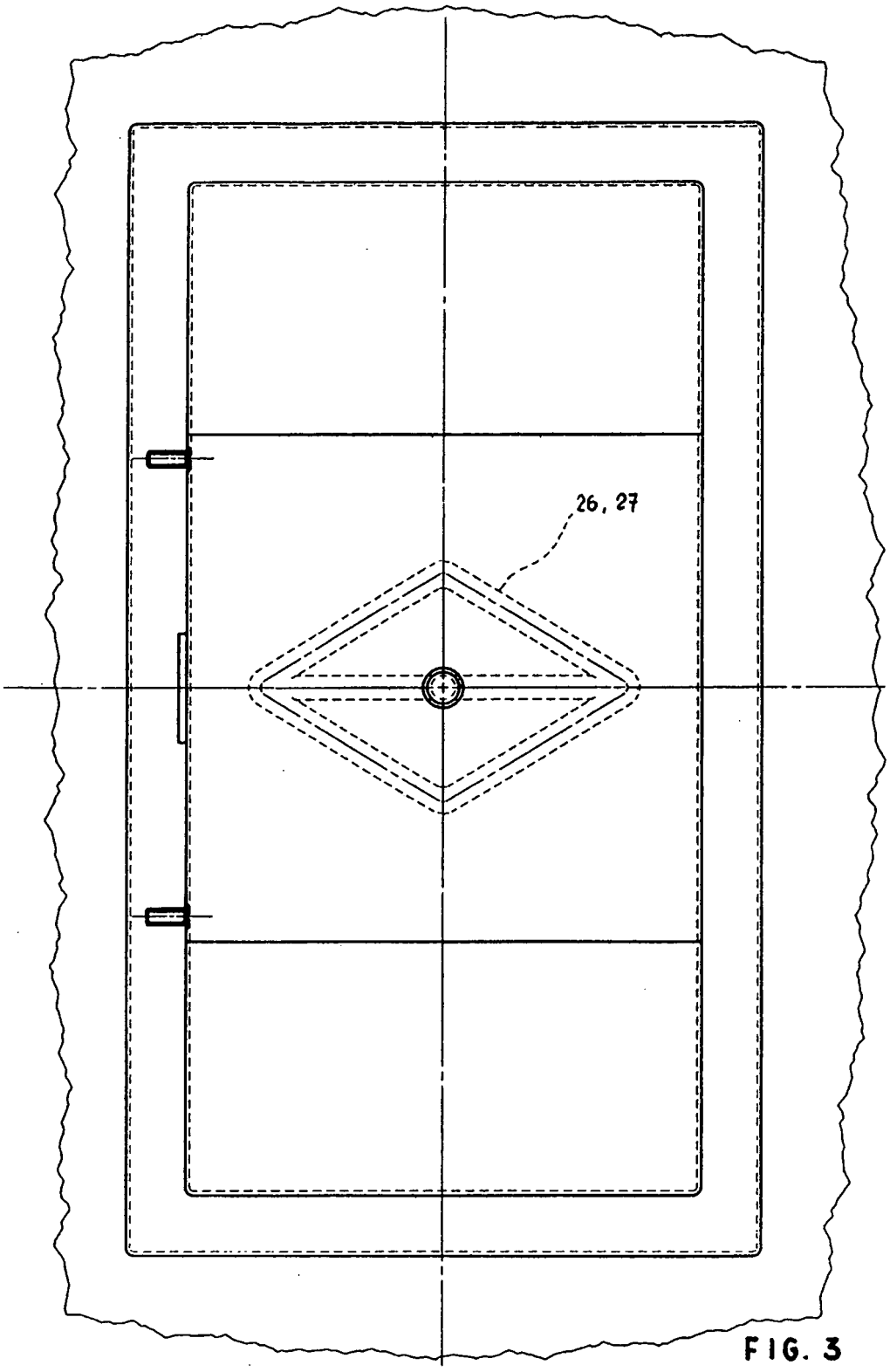

FIG. 3

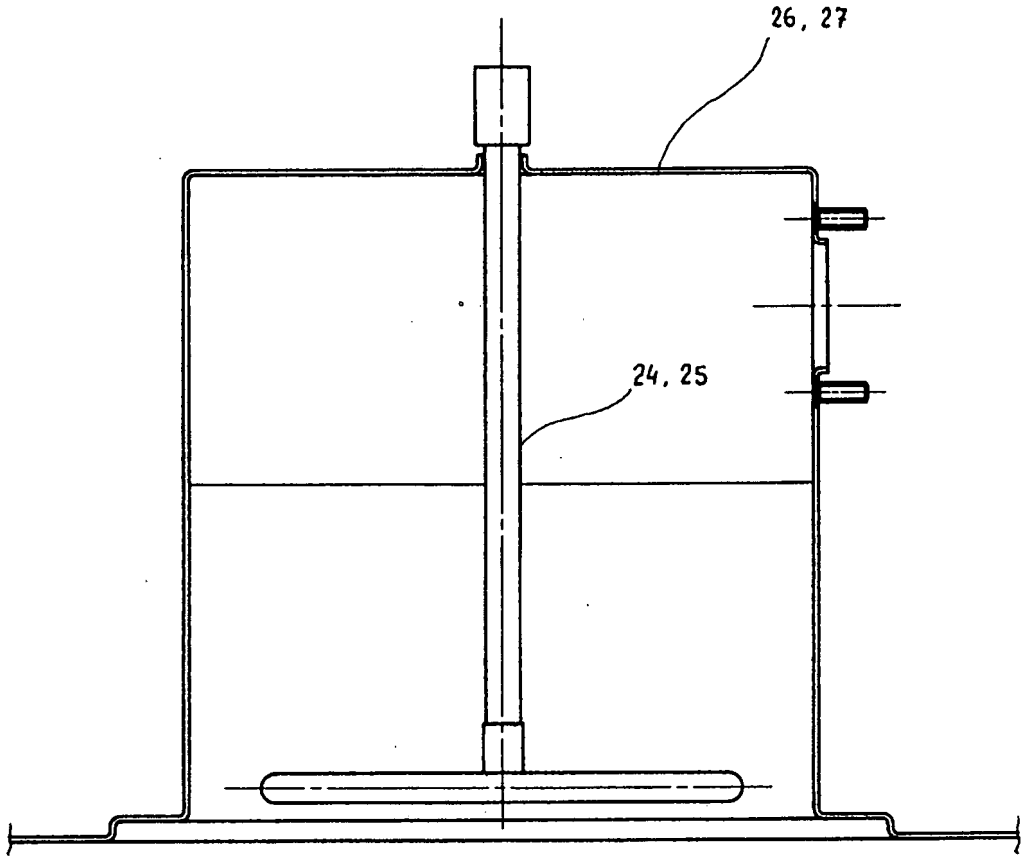

FIG. 4

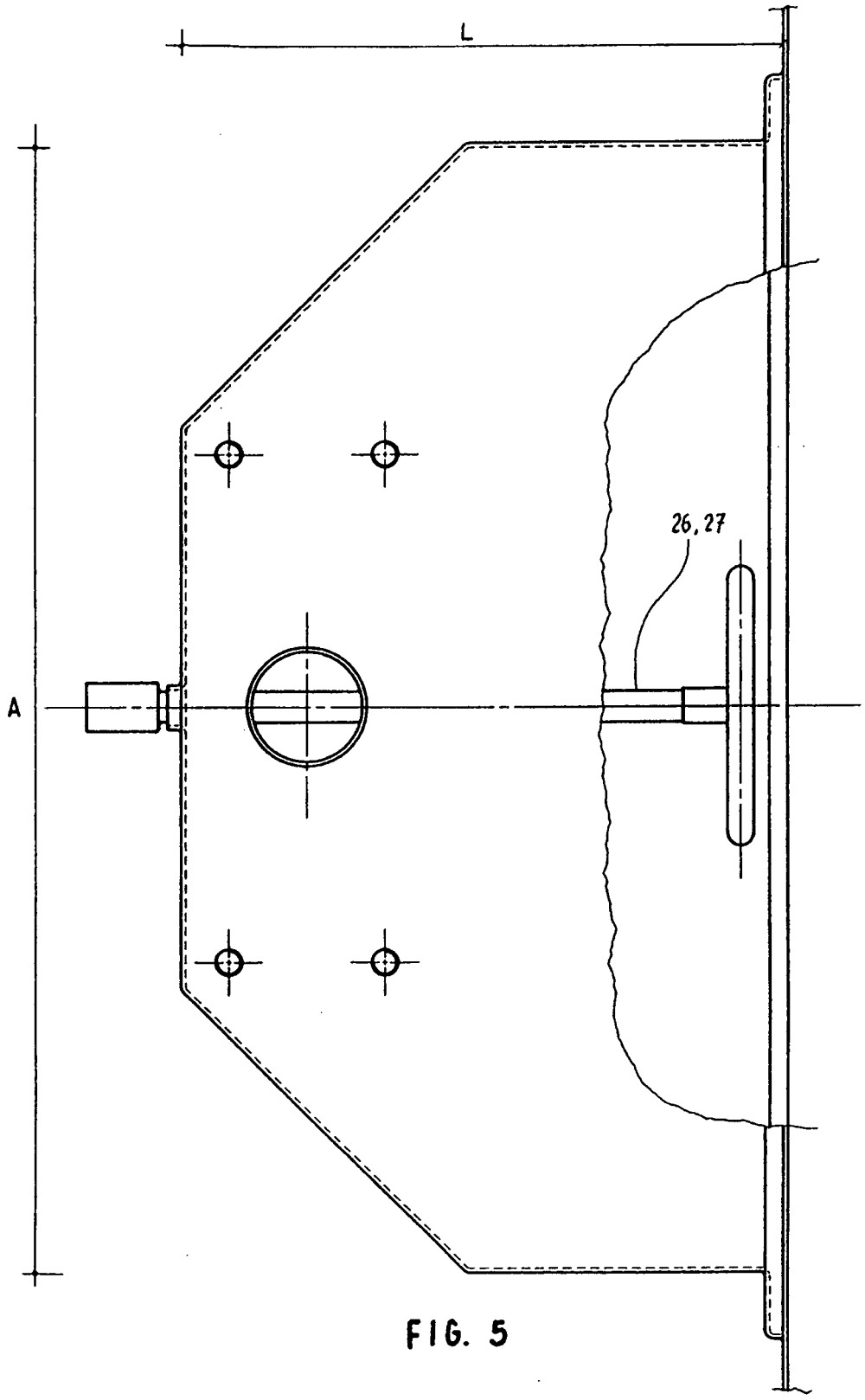

FIG. 5

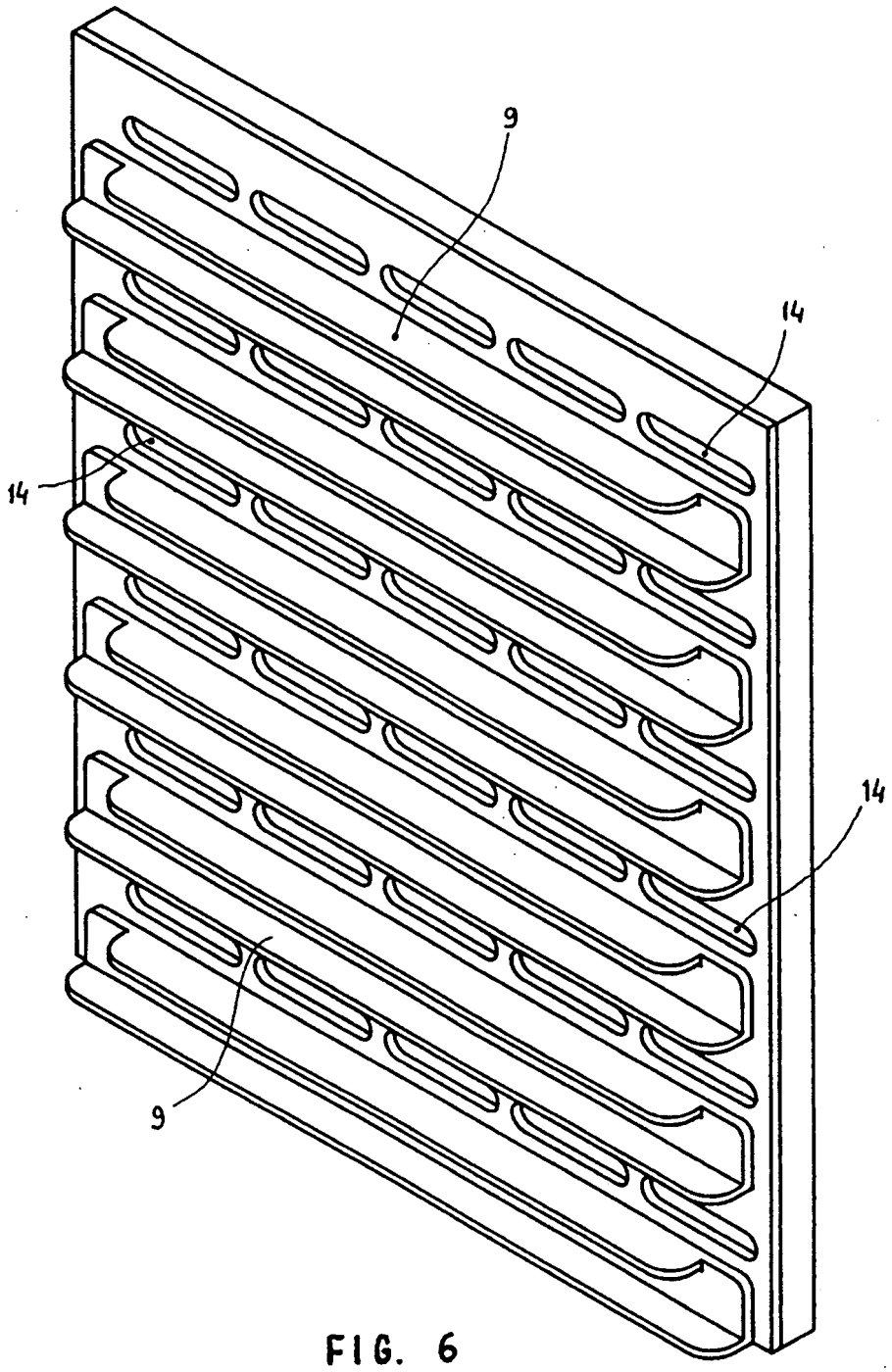

FIG. 6

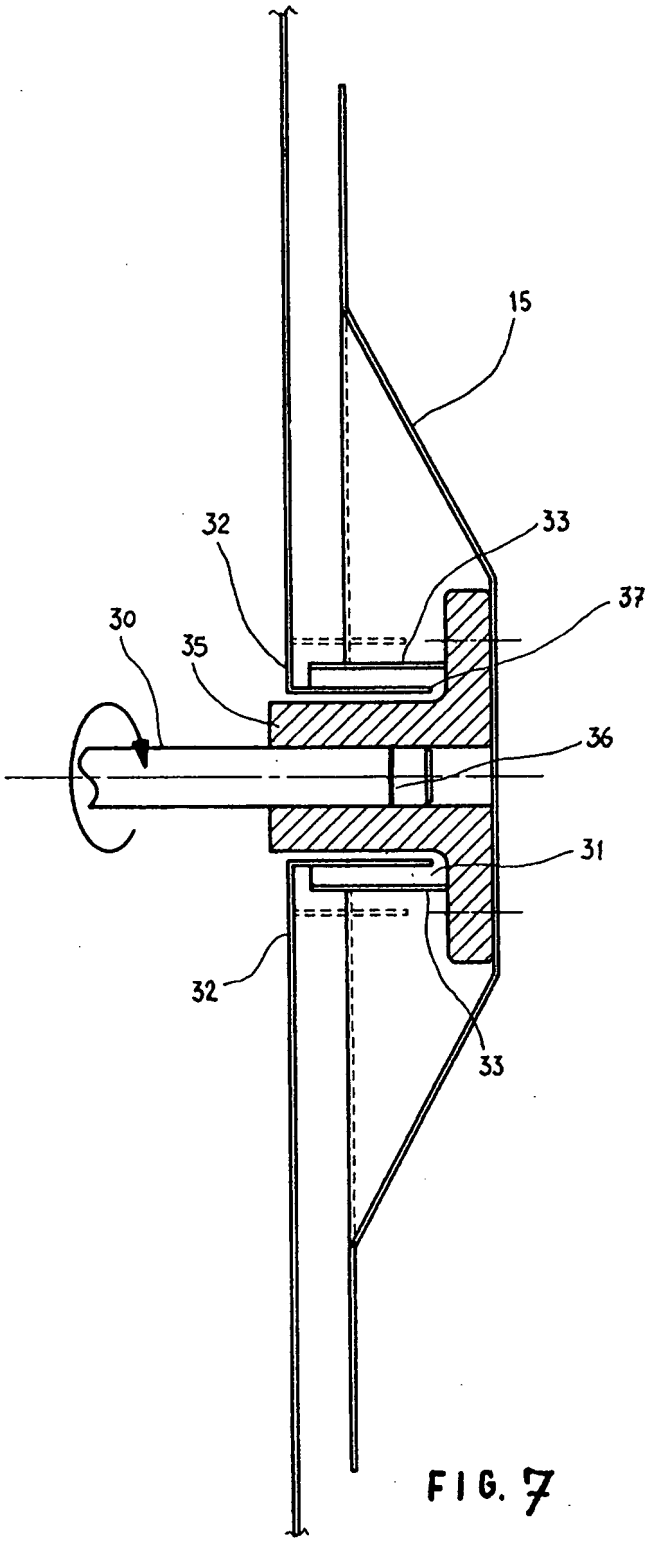

FIG. 7

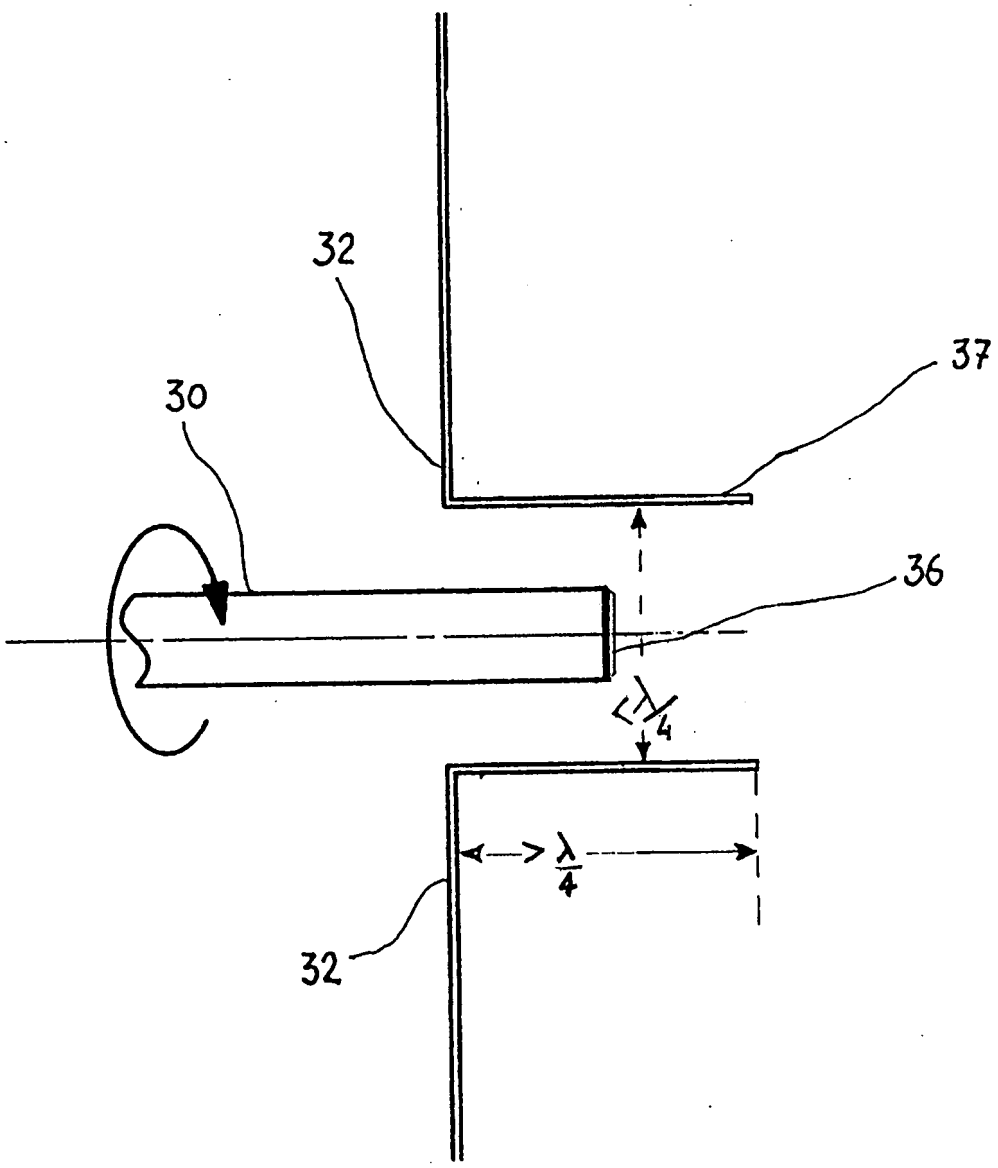

FIG. 8